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(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Installation for Crushing Used Vehicle Tires and the Like, and for Separating the Metal Parts from the Non-Metal Parts of the Crushed Material

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INSTALLATION FOR CRUSHING USED VEHICLE TIRES AND THE LIKE, AND FOR SEPARATING THE METAL PARTS FROM THE NON-METAL PARTS OF THE CRUSHED MATERIAL

ABSTRACT

An installation for crushing vehicle tires and the like and for separating the metal parts from the nonmetal parts comprises in combination: a first crusher unit (1); a first screening assembly (27) associated with said first crusher unit (1), to divide the granules into at least two groups, depending on their size; a separation section (35) to separate the metallic material from the larger granules originating from said first screening assembly (27) and to recirculate the nonmetallic material; a second crusher unit (71) which receives the granules of smaller size originating from the first screening assembly and the granules of nonmetallic material originating from said separation section (35); and downstream from said second crusher unit, a first separator means (83) to separate the metal parts from the nonmetal parts.

(Fig. 1)

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in PISTOIA

INSTALLATION FOR CRUSHING USED VEHICLE TIRES AND THE LIKE, AND FOR SEPARATING THE METAL PARTS FROM THE NON-METAL PARTS OF THE CRUSHED MATERIAL

The invention relates to an installation and to a corresponding method for crushing vehicle tires and the like, and for separating the metal parts from the non-metal parts of the product obtained.

Extremely complex installations do exist for processing used tires in order to separate the metal parts (for example the bead wires and the reinforcements) from the rubber parts or in any case from the nonmetal parts. These installations incorporate a processing line along which the used tires are crushed and subjected to a magnetic-type separation of the metal parts from the rubber, which may be graded according to the size of the granules, for the purposes of reutilizing the granular material obtained as recovered material for the production of various industrial articles, depending on the size of the granules.

Known installations which carry out these operations are particularly complex, bulky and expensive.

The subject of the invention is an installation of the abovementioned type which enables used tires to be processed and the desired separation of the metal parts from the nonmetal parts to be achieved, at comparatively very limited cost and spatial requirements in relation to equipment known to date.

Basically, according to the invention, the installation comprises in combination:

- a first crusher unit fed with pieces of tire obtained for example by means of shearing machines of a known type and described in Italian Patent Application No. 9353 A/89 filed on March 1, 1989 or in European Patent Application No. 91830469.2 filed on October 30, 1991

(the content of which is incorporated in the present description), both of which documents are held by the same proprietor; this first unit crushes said pieces to obtain granules of reduced size;

- a first screening assembly associated with said first crusher unit, to divide the granules into at least two groups, depending on their size;
- a separation section to separate the metallic material from the larger granules originating from the said first screening assembly and to recirculate the non-metallic material;
- a second crusher unit which receives the granules of smaller size originating from the first screening assembly and the granules of nonmetallic material originating from the separation section; and
- downstream from said second crusher unit, a separator means to separate the metal parts from the nonmetal parts.

Advantageously, downstream from the separator means, a second screening assembly may be arranged to divide the granules of nonmetallic material according to their size, and thereby obtain a graded, granular, nonmetallic material at the outlet of the installation, to be subsequently reutilized as recovered material.

Between the first screening assembly and the separation section, a further second separator means may be arranged which receives the granules of smaller size originating from the first screening assembly so as to separate the metallic material from the nonmetallic material, and to discharge the metallic material toward the separation section and the nonmetallic material toward the second crusher means. This further second separator means ensures that the material of smaller size obtained from the first screen is divided, thus preventing the metal or predominantly metal particles from being recirculated toward the second crusher unit.

Advantageously, in a possible embodiment, the separation section may comprise a rotor means in order to

separate the metallic material from the nonmetallic material in granules of greater size originating from the first screening assembly. Downstream from the rotor means is arranged a third separator means to separate the metallic material from the nonmetallic material and recirculating means which convey the latter toward the second crusher unit, so that the nonmetallic material can be divided into even finer particles.

The rotor may be of the type having radial blades or the like, rotating at high speed.

Since the metallic material employed in the construction of motor vehicle tires is usually iron, the separator means may be of the magnetic type, and in particular comprise belt and pulley systems having a magnetized pulley or partially magnetized rotating rollers. Devices of this type are known to experts in the field.

The first crusher unit may comprise counter-rotating blade means and, optionally, grinding means, which may be made up of counter-rotating rollers having parallel axes and helically arranged toothings so as to break up the granules which fall into the groove formed between the two rollers. Grinding means may also be incorporated in the second crusher unit.

The invention also relates to a method for crushing vehicle tires and the like and for separating the metal parts from the nonmetal parts, incorporating the following phases:

- subjecting the material to be processed to a first crushing operation;
- effecting a first screening of the crushed material;
- conveying the granules of larger size originating from the first screening toward means for separating the nonmetallic material from the metallic material and for recirculating the nonmetallic material toward means for a second crushing operation;
- subjecting the recirculated material and the granules of smaller size originating from the first screening

assembly to a further crushing operation;

- subjecting the material originating from said second crushing operation to an operation for separating out the metallic material and the nonmetallic material.

Advantageously, the nonmetallic material obtained from the separation downstream from the second crusher unit may be subjected to screening in order to grade the granules according to their size, thereby facilitating their subsequent reutilization as recovered material.

In a further possible advantageous embodiment of the method according to the invention, the granules of smaller size originating from the first crushing operation are processed in order to separate the metallic material from the nonmetallic material, thus preventing the metallic material already separated from the nonmetallic material from being recirculated.

According to a further embodiment, the installation comprises in combination: a crusher unit having a plurality of grinding stages; a first crusher which receives the material from the crusher unit; a first magnetic separator or apparatus for removing ferrous metal from the material originating from the first crusher; a further grinding stage; a second crusher; at least a second ferrous metal removing apparatus; a series of screens in a cascade arrangement for separating the granules; a suction unit having suction terminals at least from the crushers and having a trap-mechanism separator which discharges the material into microprojection oscillating separator and conveyor units, in order to reintroduce said material into the cycle and to separate the fibers; apparatuses for the recovery of the ferromagnetic metal; and conveyance means of the shakes, cup, screw, or equivalent type.

Further advantageous embodiments of the method and installation according to the invention are indicated in the accompanying claims.

The invention will be more clearly understood by following the description and accompanying drawing, which latter shows a practical, nonlimiting illustrative embodiment of said invention. In the drawing:

Fig. 1 shows a diagram of the installation according to the invention;

Fig. 2 shows a detail of the blades in the crushing assembly;

Fig. 3 shows a further detail of the crushing assembly;

Fig. 4 shows a detail of the bladed rotor used to separate the metallic material from the nonmetallic material of the granules of greater size originating from the first screening assembly;

Fig. 5 shows a diagrammatic side view of the installation according to the invention;

Fig. 6 shows an end view thereof;

Fig. 7 shows a plan view in even greater diagrammatic fashion;

Fig. 8 shows a diagram of the devices associated with the suction means;

Figs. 9, 10 and 11 show an oscillating conveyor system for separating the granules from the fibers, according to a cross section along IX-IX of Fig. 10, according to a cross section along X-X of Fig. 9, and according to a plan view along XI-XI of Fig. 10, respectively;

Fig. 12 shows an explanatory diagram.

The installation as a whole is diagrammatically illustrated in Fig. 1. The tire pieces sheared by shears (not shown) are fed in the direction of the arrow f to a first crusher unit, indicated as a whole by 1 and comprising a first pair of bladed rollers 3, 5 and a second pair of bladed rollers 7, 9. Each bladed roller has a plurality of toothed disks of the type indicated in Fig. 2 and designated as a whole by 11. These disks have toothings 13 oriented tangentially so as to shear and crush the product which falls into the groove between the

two rollers 3, 5 and 7, 9 respectively. The teeth of the rollers 7, 9 are smaller in size than the teeth of the rollers 3, 5, in order that, from the first to the second pair of rollers, a finer crushing is obtained. Associated with each of the rollers 3, 5, 7 and 9 are cones 15 which delimit the area into which the material falls, shaped (as diagrammatically indicated in Fig. 3) by a series of teeth 17 which penetrate between adjoining disks 11. The first crusher unit 1 additionally comprises a pair of grinding rolls 21, with which are associated cones 23 similar to the cones 15, and which are fitted with helically oriented toothings in such a way that the material falling into the groove formed between the rolls 19, 21 is subjected to forces of opposite directions on the part of the toothings of the respective rolls. At the inlet of the groove between the assemblies 19 and 21 is arranged a cylinder 25 which increases the points of contact between the material and the grinding rolls 19, 21, thereby improving the efficiency of the grinding assembly. The toothing of the grinding assembly is such as to further reduce the size of the granules originating from the rollers 7, 9.

The material ground and crushed by the crusher unit 1 falls in the direction of the arrow f2 toward a first screening assembly indicated as a whole by 27 and comprising a sieve 29 which effects a first separation of the granular material according to its size. In a possible embodiment, this sieve is a vibrating sieve having a 3 mm square mesh. The finer material is collected on a chute 31 whereas the coarser material is discharged in the direction f3 onto a chute 33 which conveys said material toward a station for separating the metallic material from the nonmetallic material, indicated as a whole by 35. The station 35 has a member 37 comprising a rotor having radial blades, the configuration of which is diagrammatically indicated in Fig. 4. The rotor is made up of a collection of blades mounted on an axle 39 and

having cutting edges 41 radially arranged, in the example shown in the drawing, at angles of 120° to each other. Further cutting edges, for example four arranged at 90°, can also be provided. The rotor, indicated as a whole by 43 in Fig. 4, is rotated at high speed (approximately 3,000-4,000 revolutions/minute) by means of an electric motor 45 and a pulley 47.

The granular material of greater size originating from the first screening assembly 27 enters the device 37 where it is subjected to the action of the radial blades 41 which, rotating at high speed, separate out the nonmetallic material, in this case rubber, from the metallic material (in particular iron) of the granules of greater size originating from the sieve 29. A granular product therefore emerges at the outlet 49 of the device 37, in which the metallic material is substantially separated from the nonmetallic material. Downstream from the outlet 49 the material is conveyed onto a separator means 51 comprising a flexible member 53 running around two pulleys 55 and 57, the second of which is magnetized so as to separate the ferromagnetic material, which is discharged in the direction of the arrow f4, from the nonferromagnetic material which is discharged in the direction f5. A collection means, for example a conveyor belt 59, is arranged at the outlet of the ferromagnetic material whereas a means for recirculating the material, for example a screw or a cup-type lifting device, indicated as a whole by 61, is arranged at the outlet of the nonmetallic material.

Downstream from the first screening assembly 27 is arranged a further means for separating the metal parts from the nonmetal parts, indicated as a whole by 63 and, similarly to the means 51, made up of a pair of pulleys 65, 67 around which runs a belt 68. The pulley 67 is magnetized so that the ferromagnetic parts are discharged in the direction of the arrow f6 onto the chute 33 whereas the nonferromagnetic parts are discharged in the direction f7 onto a conveyor belt 69 which conveys these particles toward a second crusher unit 71

made up of a pair of grinding rolls 73, 75 together with a cylinder 77 above these, equivalent to the grinding rolls 19, 21 and to the cylinder 25 of the crusher unit 1, but having finer toothings so as to further reduce the size of the granules.

Arranged downstream from the second crusher unit 71 is a conveyor belt 81 which conveys all the material subjected to the second crushing operation to a separator means 83 made up of a partially magnetized roller which discharges the nonferromagnetic material in the direction of the arrow f8 toward a second screening assembly 85, and the ferromagnetic material in the direction of the arrow f9 onto a chute 87 which conveys the metallic material toward the conveyor belt 59.

The second screening assembly 85 comprises three vibrating sieves in series, indicated by 89, 91 and 93 respectively, and of decreasing mesh aperture. Associated with each sieve are means for collecting and discharging the screened material indicated by 95, 96, 97 and 98 respectively.

Operation of the installation may be summarized as follows: the material to be processed, originating from a shearing machine (not shown), is first crushed in the crusher unit 1. The granular material obtained is subjected to the first screening in the screening assembly 27, at the outlet of which the material of larger size is conveyed into the device 37 which separates the rubber from the iron in the larger granules. At the outlet of the device 37, the ferrous metal removing device 51 magnetically separates the ferrous material which is discharged onto the conveyer 59, from the nonferrous material which is discharged toward the cup lifting device 61 so that it can be reintroduced into the cycle. The granular material of smaller size, and in particular that having a diameter of less than 3 mm, is discharged onto the ferrous metal removing device 63 which conveys the metallic material toward the device 37 in order that said material advances along the path toward the conveyor belt 59, and the

nonferrous material toward the conveyor 69. As can be diagrammatically seen in Fig. 1, the nonmetallic material originating from the ferrous metal removing apparatus 51 is also discharged onto the conveyor 69 and made to recirculate via the cup lifting device 61.

Therefore, all the material originating from the first screening assembly 27, and whose iron content is not sufficiently high to guarantee that separation will be carried out by the ferrous metal removing apparatuses 63 and 51 respectively, is conveyed onto the conveyor belt 69. This material conveyed by the conveyor belt 69 is discharged into the second crusher unit 71, at the outlet of which the ferrous metal removing apparatus 83 carries out a final separation of the ferromagnetic parts - which are discharged onto the chute 87 - from the nonferromagnetic parts. The latter are sieved and graded by the screening assembly 85 so that on the discharge means 95, 96, 97, 98 fractions are collected of nonferromagnetic granular material of varying size, to then be reutilized as recovered product.

As illustrated in the enclosed Figs.5-12, 101, 103, 105 indicate three pairs of blade and grinding rollers of a first crusher complex, indicated as a whole by 107, grind the sheared pieces of tire which are gravity-fed to the assembly 107. Each pair of blade rollers has a plurality of toothed disks similar to those already illustrated with reference to assembly 1 of Fig.1. The disks of the two rollers of each pair have different rotational and peripheral speeds respectively so as to produce the shearing action, and the subsequent pairs of rollers generate a gradually increasing crushing action on the tire pieces. The material crushed in this way is collected by a first conveyor 110 which feeds the material to a first crusher 112. Advantageously, the conveyor 110 (as well as the other conveyors described below) is of the oscillating type and is therefore able to impart to the individual particles upward (micro-projection) and forward trajectories and projection relative to the jerky and undulatory motion imparted to

the surface structure of the conveyor, so that the individual particles may also be moved upward. The material from the conveyor 110 reaches the first crusher 112 to the side of the latter; this crusher has already been partly defined with reference to the embodiment of Fig. 1.

The crusher 112 is a crusher having radial blades formed by star-shaped tools mounted on a central shaft of the rotor, the blades being arranged in a substantially helical pattern so that, in addition to the material's being crushed, it is also made to advance in an axial direction as shown by the arrows f112 in Fig. 6, whereby the crushed material in said crusher 112 may be collected in a second conveyor 114; with the latter interacts a first magnetic separator or ferrous metal removing apparatus 116 which is located above the conveyor 114 and is provided with a continuous band which is made to pass very closely over the conveyor 114 so as to draw up the ferromagnetic particles present in the conveyed material; the ferromagnetic material - in particular free iron or steel particles or those carrying only very small adhering particles of rubber - is discharged from the ferrous metal removing apparatus 116 as indicated by the line 118 by a shaving implement or other means. The residual material conveyed by the conveyor 114 is made to drop into a tubular column 120 whereby it reaches a horizontal screw 122, which extends through the lower section of the installation up to a lifting device 124, this being of the screw-, cup-, or similar type and arranged to the side of the unit. From the lifting device 124 the material is fed to a further grinding stage 126, similar to the grinding stages of the assembly 107. From the subsequent grinding stage 126, a conveyor 128 similar to the previous ones, transfers the material to a second crusher 130 which, similarly to the crusher 112, is also of the blade type; in said crusher 130 also, the material follows a substantially axial path to then be discharged into a screen 132. On its path and processing through

this screen 132, the material is subjected to the action of a second ferrous metal removing apparatus 134 similar to the one 116 and located above the screen 132, in order to separate out other ferrous particles which are conveyed along a line 136 to join the ferrous material obtained from the line 118 originating from the ferrous metal removing apparatus 116. The material retained by the screen 132 is discharged via a line 138 (Fig.12) into the horizontal screw conveyor 122 and is also optionally introduced into a tubular drop column 120. The material which has passed through the screen 132 is discharged onto a third ferrous metal removing apparatus 140, in which the ferrous material which is separated out is conveyed along 142 to be recovered together with the material originating from the ferrous metal removing apparatuses 116 and 134 along the paths 118 and 136; the nonferrous material discharged from the ferrous metal removing apparatus 140 is fed along a path 144 to an inclined screw 146 to be lifted upward. From the lifting screw 146 the material is fed to the first 148 of a series of screens 148, 150 and 152 which operate in a cascade arrangement so as to carry away the granules which are in decreasingly smaller pieces by corresponding outlets indicated as a whole by 154.

Associated with the installation described is a suction unit 156 which draws up the particles from the first crusher 112, from the second crusher 130 and also from the inclined lifting screw 146 along conduits 158, 160 and 162 respectively, using pneumatic vacuum conveying means. Both very small particles of rubber material and mainly synthetic fiber material arising from the presence of the polyester plies are drawn along these conduits. The material pneumatically collected in this way is directed toward a separating trap-mechanism having a chamber in which the flow decelerates and where separation of the particles from the air conveying them occurs as a result of gravity; via a conduit 166, the air reaches a filtering assembly 168 which comprises cloth sleeves or the like to ensure that any residual particles

are retained. The particles separated in the chamber 164 of the trap mechanism are delivered via a star-shaped valve 170 to the first of two separator and conveyor units, indicated as a whole by 172 and 174, of substantially identical structure and which will be described below, so as to separate the fibers from the particles of varying particle size; in particular the first device 172 separates out tufts of fibers at 176 and large rubber particles at 178 which are then directed to the conveyor 114 to be directed to the first ferrous metal removing apparatus 116, whereas the particles which have passed through the screen 172 reach the second unit 174 which is similar to the previous one and separates out fiber tufts at 180, the material retained by the screen being conveyed along the line 182 to the screen 132, whereas the material passing through the screen of the unit 174 follows a line 184 to a further separator 186 which separates out further tufts of fiber at 188 whereas the comparatively very fine granular material continues along the line 190 to reach the first screen 148 for a further final screening; the tufts of fibers from the outlets 176, 180 and 188 may be combined so as to reutilize said fibers.

Each of the units 172 and 174 is more clearly illustrated in Figs. 9, 10 and 11. With reference to the unit 172, this receives the material separated out in the trap mechanism 164 via the star-shaped valve 170. The separator conveyor comprises a channel with a screen-base 271 and with a series of small blades 273 oriented in a zigzag pattern off the sides of the channel and raised above the base of the channel 271 to a limited degree for purposes which will be indicated below; the channel ends with an outlet 275 on one side and another outlet 277 on the other side, in proximity to a directional element 279 attached to the base 271. The material received in the channel of the unit 172 comprises rubber particles and polyester fibers. An oscillating conveyor system sets the

screening channel 271 in motion. The granules fed in are conveyed in microjumps in the rectilinear direction f100 toward the outlet 275 passing beneath the blades 273. During the microjumps the heavier rubber granules tend to become concentrated in a bottom layer and therefore pass beneath the blades 273, whereas the polyester ply fibers mixed in with the rubber granules, being lighter, become concentrated on the surface of the granular flow; by continuing with the microjumps, the surface fibers tend to combine together to form "tufts" of approximately 15-30 mm in diameter. As a result of their size and their lightness the "tufts" are guided by the blades 273 which force them to follow a zigzag path which encourages deformation of said tufts and forces them to exit through a side outlet. So as to divide the two products through two different outlets, the directional element 279 is provided on the final section of the channel and has an inclination opposite to that of the last blade 273A and is of a height which does not interfere with the advance of the tufts, but directs the rubber granules toward the outlet 275, that is to the line 178. The tufts of fibers from the blade 273A are instead directed toward the outlet 277, that is to the line 176. The material which has passed through the screen-base 271 reaches the second unit 174 which is similar to the previous unit and has outlets 180, 182 and 184 as described above.

It will be understood that the drawing merely shows an illustrative embodiment which is given purely as a practical demonstration of the invention, it being possible to vary said invention as regards shapes and arrangements without thereby departing from the scope of the concept underlying said invention. The presence of any reference numerals in the accompanying claims has the purpose of facilitating reading of the claims with reference to the description and to the drawing and does not limit the scope of protection represented by the claims.

CLAIMS

1. An installation for crushing vehicle tires and the like and for separating the metal parts from the nonmetal parts, comprising in combination:
- a first crusher unit (1; 107);
- a separation section (35; 112) to separate the metallic material from the granules fed from said first crusher unit (1; 107) and to recirculate the nonmetallic material;
- a second crusher unit (71; 126) which receives nonmetallic material from said separation section (35; 112);
- downstream from said second crusher unit (71; 126) a first separator means (83; 134) to separate the metal parts from the nonmetal parts; and
- screening means (89, 91, 93; 148, 150, 152) to divide the granules according to their size.

2. The installation as claimed in claim 1, wherein a first screening assembly (27) is associated with said first crusher unit (1), to divide the granules into at least two groups, depending on their size; and wherein the larger granules originating from said first screening assembly (27) are fed to said separation section (35) while the granules of smaller size are fed to said second crusher unit (71).

3. The installation as claimed in claim 1, wherein downstream from said first crusher unit (107) there is provided a first separation section (112) and first separation means (116) to separate the metallic parts from the nonmetallic parts; wherein conveyer means (122; 124) are provided for feeding the nonmetallic parts originating from said separation means (116) to said second crusher unit (126); and wherein downstream from said second crusher unit (126) there are provided a further separation section (130) and second separation means (134) to separate metallic parts from nonmetallic

parts, and screening means (132, 148, 150, 152) to divide the granules of nonmetallic material according to their size.

4. The installation as claimed in claim 3, wherein said screening means (132, 148, 150, 152) comprise a first screen (132) which divides the granules into two groups, the granules of larger dimension being recirculated toward the second crusher unit (126) and the granules of smaller size being fed to a separator of metallic parts (140), the nonmetallic parts being fed to further screening means (148, 150, 152).

5. The installation as claimed in claim 2, wherein downstream from said first separator means (83) a second screening assembly (85) is arranged to divide the granules of nonmetallic material according to their size.

6. The installation as claimed in claim 2, wherein between said first screening assembly (27) and said separation section (35), a second separator means (63) is arranged which receives the granules of smaller size originating from said first screening assembly (27) so as to separate the metallic material from the nonmetallic material, said second separator means (63) discharging the metallic material toward said separation section (35) and the nonmetallic material toward said second crusher unit (71).

7. The installation as claimed in claim 2, wherein said separation section (35) comprises a rotor means (37) in order to separate the metallic material from the nonmetallic material of the granules of greater size and, downstream from said rotor means (37), a third separator means (51) to separate the metallic material from the nonmetallic material, recirculating means (61) being provided to convey the latter toward the second crusher unit.

8. The installation as claimed in claim 7, wherein said rotor means (37) has a radially bladed rotor (41).

9. The installation as claimed in claim 2, wherein said separator means (51, 63, 83) are magnetic separator means.

10. The installation as claimed in claim 2, wherein said first crusher unit (1) comprises counter-rotating blade means (3, 5; 7, 9) and, optionally, grinding means (19, 21).

11. The installation as claimed in claim 1, wherein said second crusher unit (71) comprises grinding means (73, 75).

12. The installation as claimed in claim 10 or 11, wherein said grinding means comprise two counter-rotating rollers with helical toothings, arranged with parallel axes and forming a groove within which the material is crushed.

13. A method for crushing vehicle tires and the like and for separating the metal parts from the nonmetal parts, incorporating the following phases:

- subjecting the material to be processed to a first crushing operation;
- conveying the granules toward means for separating the nonmetallic material from the metallic material and for recirculating the nonmetallic material toward means for a second crushing operation;
- subjecting said recirculated material and the granules of smaller size, originating from the first screening, to a further crushing operation;
- subjecting the material originating from said second crushing operation to an operation for separating out the metallic material and the nonmetallic material.

14. The method as claimed in claim 13, wherein the granules from said first crushing operation are subjected to a first screening and the granules of smaller size originating from said first screening are processed in order to separate the metallic material from the nonmetallic material, the nonmetallic material being subjected to said second crushing operation.

15. The method as claimed in claim 13, wherein the nonmetallic material originating from said second crushing operation is screened so as to divide it according to the size of the granules.

16. The method as claimed in claim 11, wherein the separation of the metallic material from the nonmetallic material is carried out by means of magnetic systems.

17. The method as claimed in claim 14, wherein the separation of the nonmetallic material from the metallic material of the granules of larger size originating from the first crushing operation, is carried out by subjecting the material to the action of a radially bladed rotor.

18. The method as claimed in claim 14, wherein the first screening of the crushed material is effected by separating out the granules of less than 3 mm in diameter.

19. The installation as claimed in claim 1, comprising in combination: a crusher unit (107) having a plurality of grinding stages (101, 103, 105); a first crusher (112) which receives the material from the crusher unit (107); a first magnetic separator or apparatus for removing ferrous metal (116) from the material originating from the first crusher (112); a further grinding stage (126); at least a second ferrous metal removing apparatus (134 or 140); a series of screens (148, 150, 152) in a cascade arrangement for separating the granules; a suction unit (156) having suction terminals (158, 160, 162) at least from the crushers (112, 130) and having a trap-mechanism separator (164) which discharges the material into microprojection oscillating separator and conveyor units (172, 174), in order to reintroduce said material into the cycle and to separate the fibers; apparatuses (118, 136, 142) for the recovery of the ferromagnetic metal; and conveyance means of the shake, cup, screw, or equivalent type.

20. The installation as claimed in claim 19, comprising a screen (132) situated downstream from the second crusher (130), followed by a second ferrous metal removing apparatus (134) for the material retained by said screen (132) and conveyed back to said further grinding stage (126), and by a third ferrous metal removing apparatus (140) for the material which has passed through said screen (126) and is directed to the abovementioned series of screens (148, 150, 152).

21. The installation as claimed in claim 19, wherein the oscillating separator and conveyor units (172, 174) are fitted with successive directional blades (273) which are raised above the vibrating and screening base (271) to convey the fiber material which tends to become concentrated at the surface and to agglomerate into tufts in a zigzag pattern, and with a directional element (279) to discharge the granules (275) separately from the fiber material (from 277).

22. The installation as claimed in claim 19, comprising, as the conveyance means, oscillating conveyors (110, 114, 128, 132) some of which (114, 132) interact with the ferrous metal removing apparatuses (116, 134), and screw- and/or cup-conveyors (122, 124, 146) for recycling the material.

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Fig.1

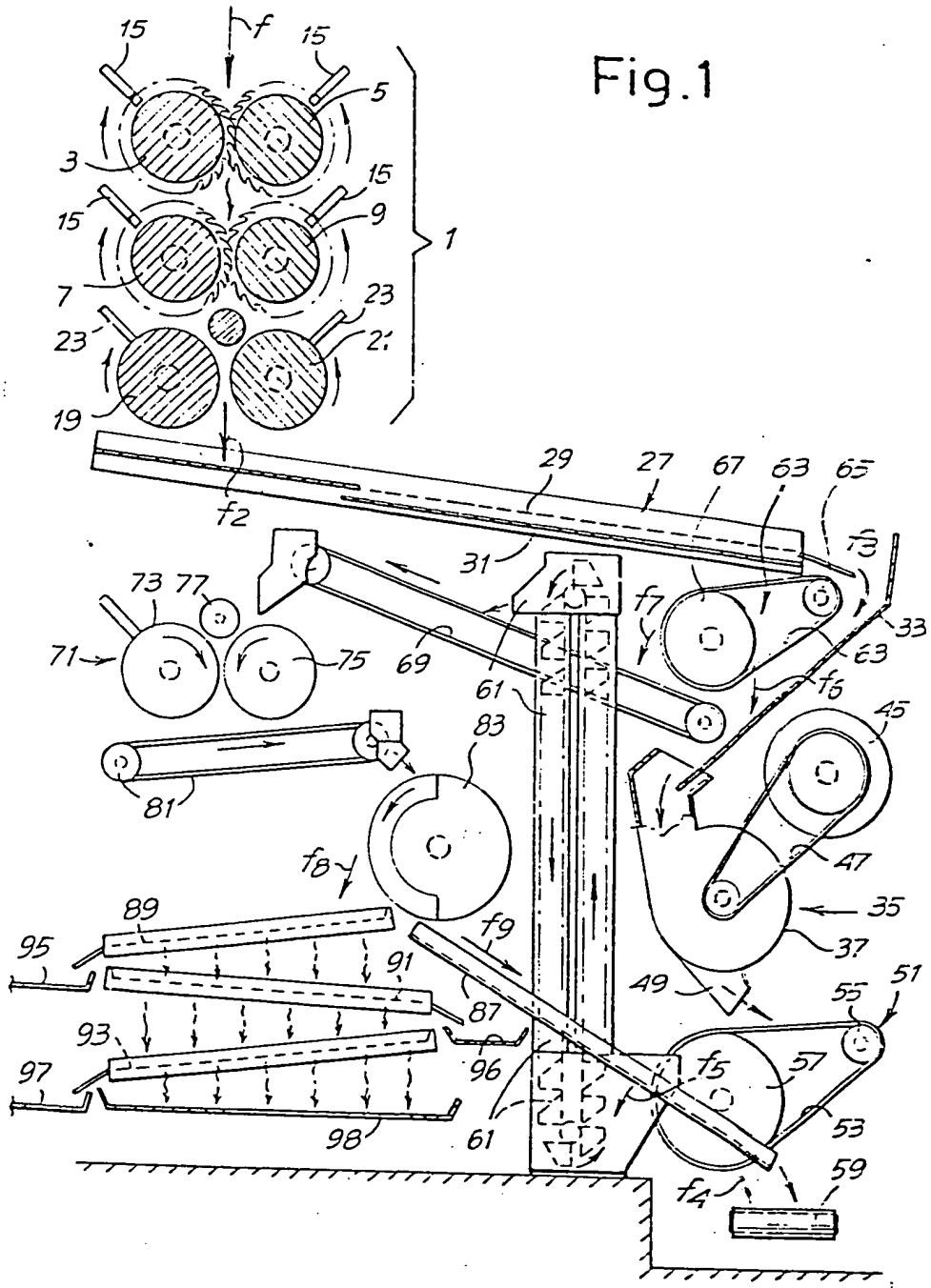

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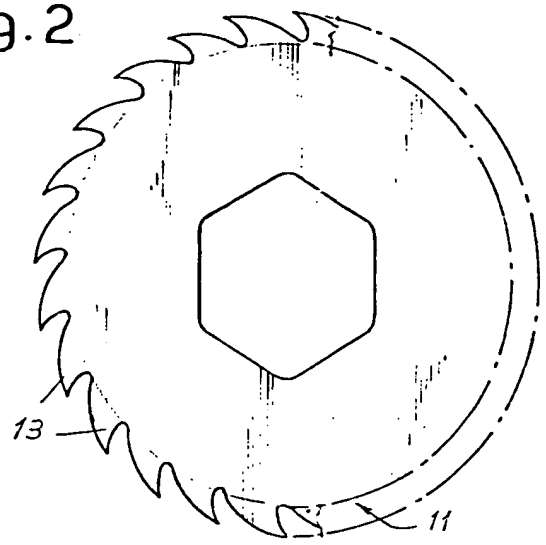
Fig. 2



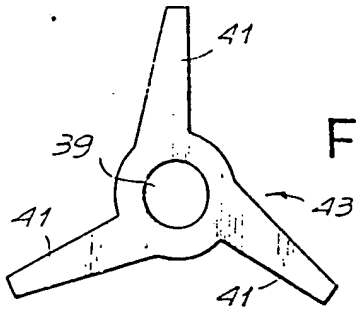


Fig. 4

Fig. 3

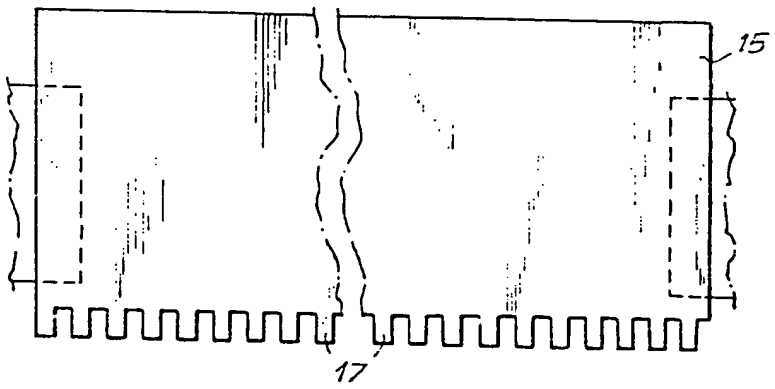


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Fig. 5

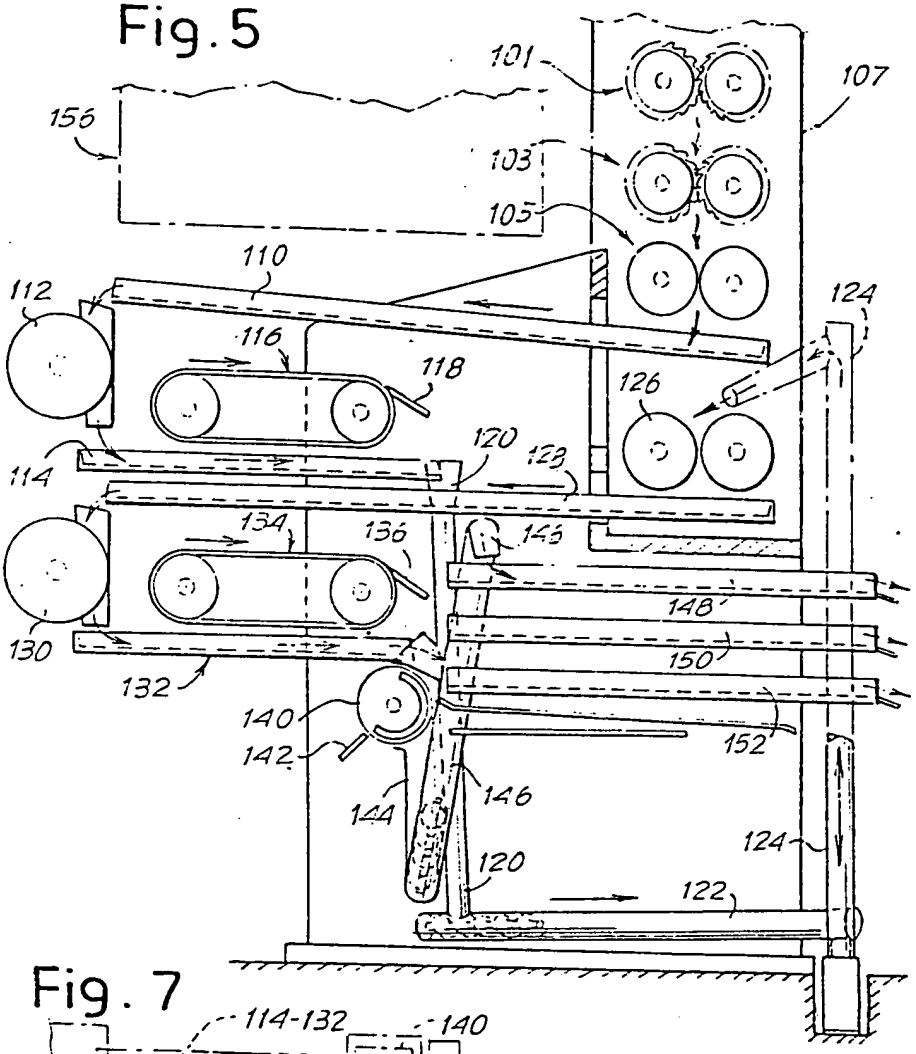

Fig. 7

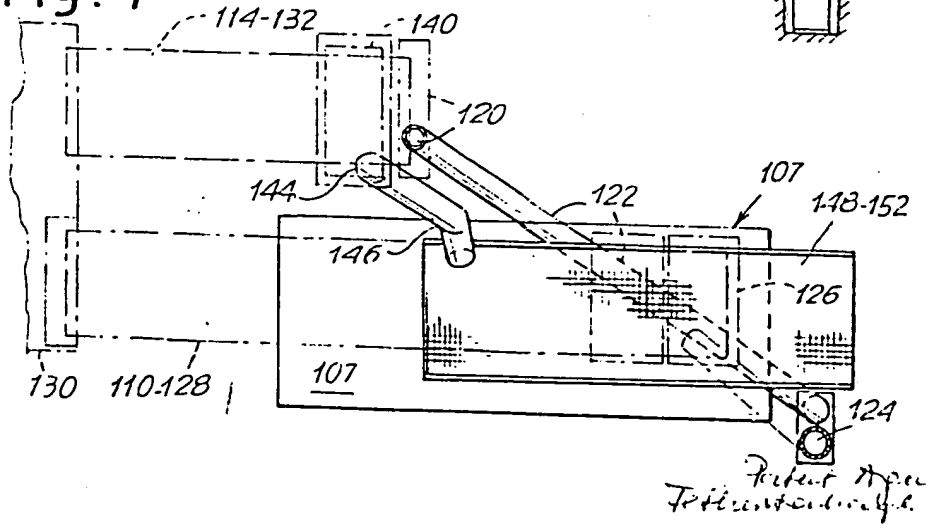

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Fig. 6

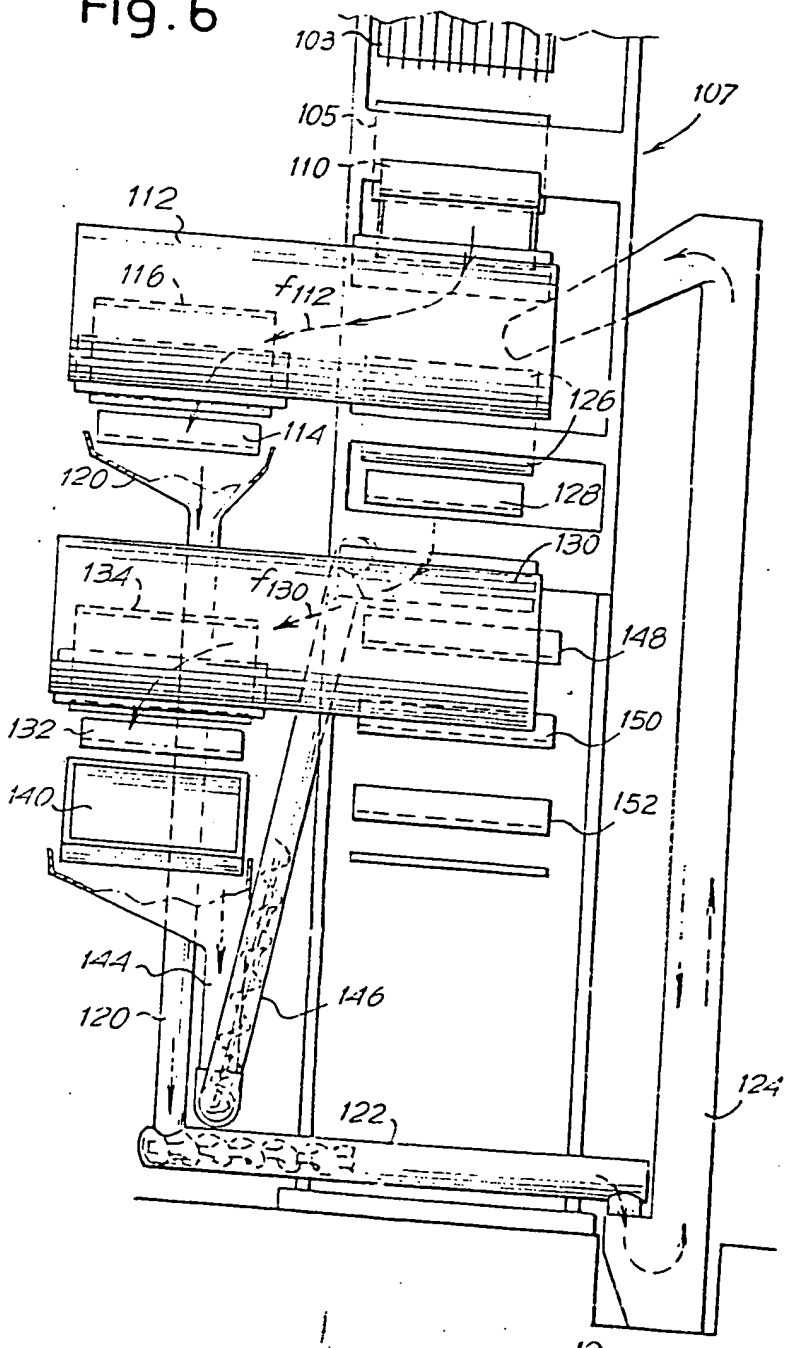

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Fig. 8

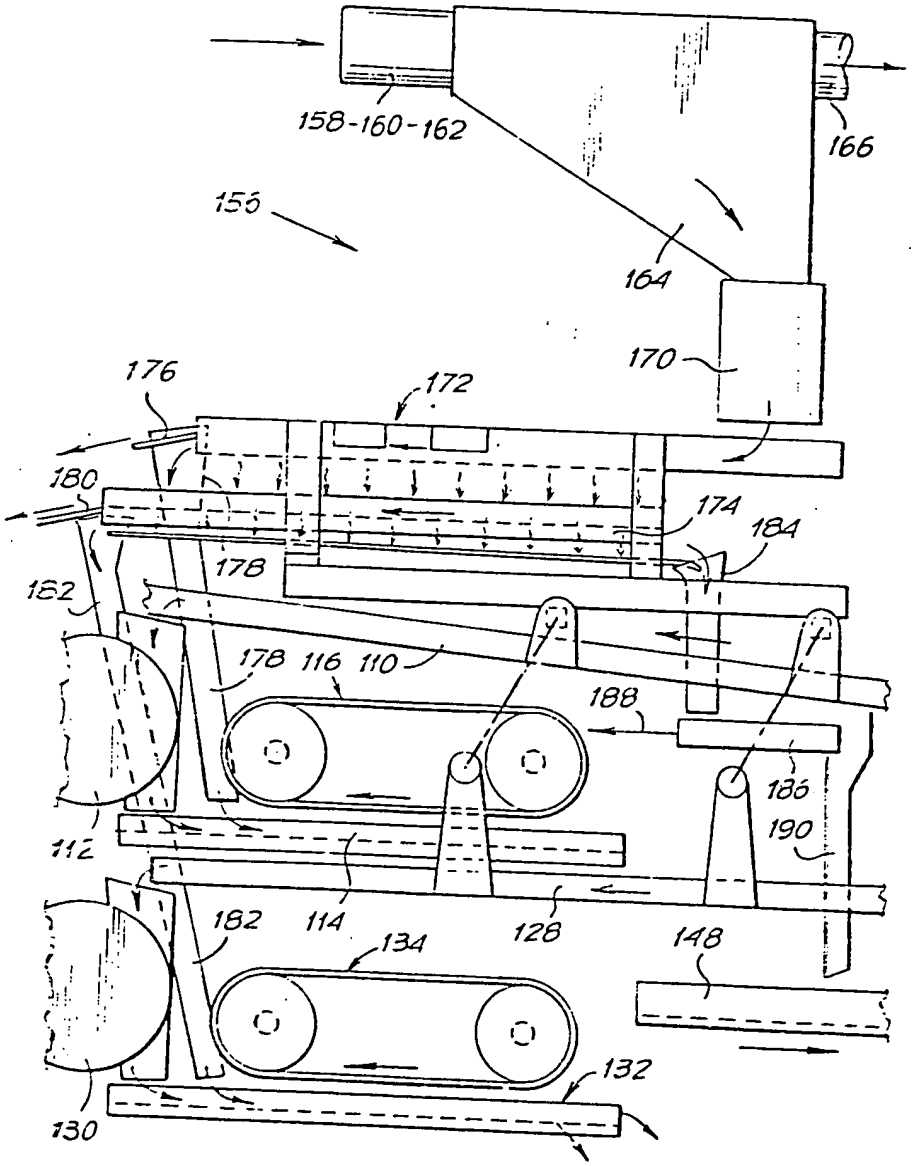

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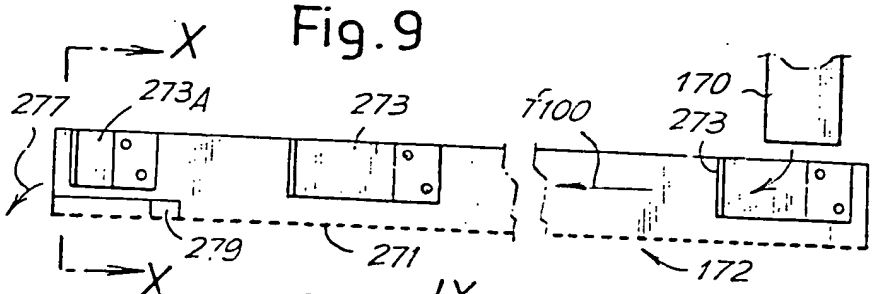
Fig.9



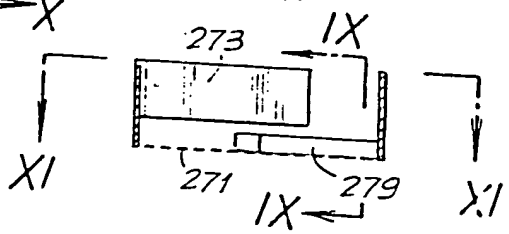


Fig.10

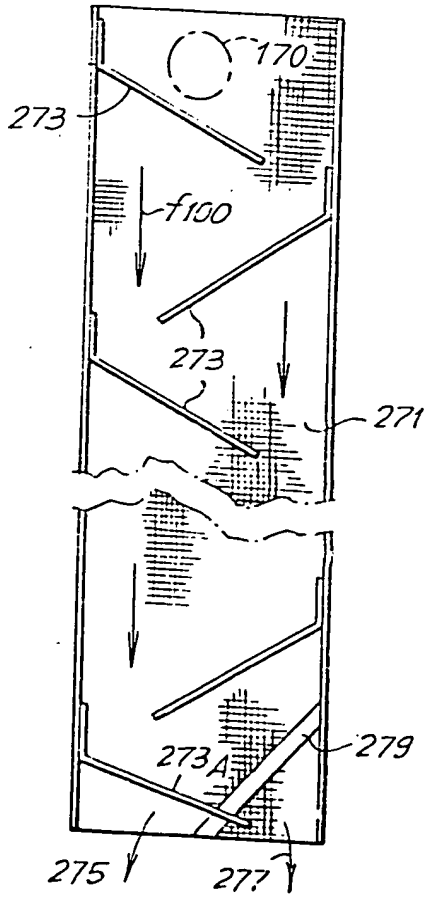


Fig.11

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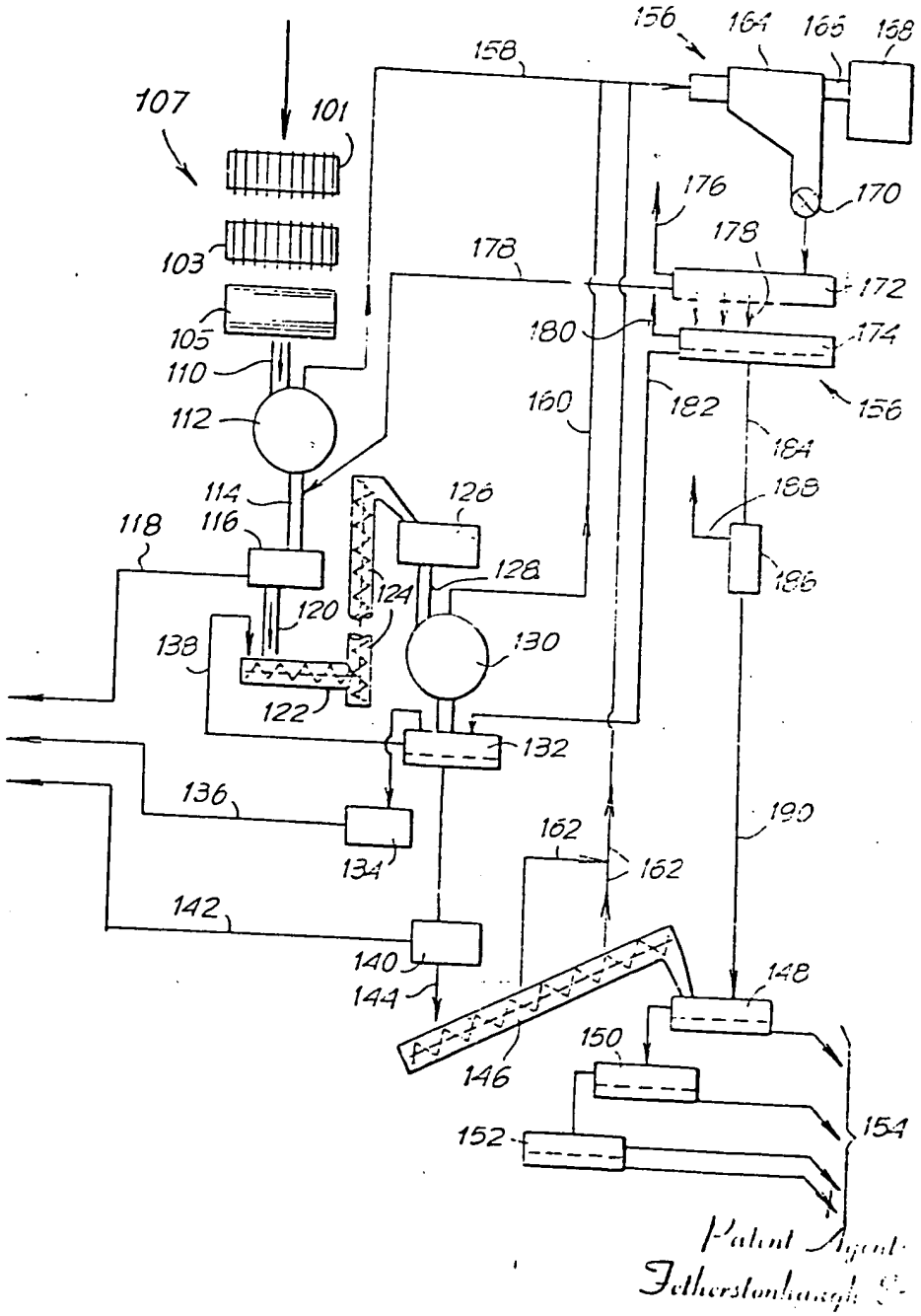
Fig.12



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